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U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Ocean Survey
Rockville, Maryland 20852

PREPRINT

NATIONAL GEODETIC SURVEY DATA AVAILABILITY - EXPLANATION - APPLICATION

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National Geodetic Survey

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NATIONAL GEODETIC SURVEY DATA

AVAILABILITY - EXPLANATION - APPLICATION *

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Introduction

For more than 150 years, the Coast and Geodetic Survey collected and published data related to the oceans and the land. With the formation of the National Oceanic and Atmospheric Administration (NOAA) in October 1970, the Coast and Geodetic Survey became a major line component of this agency and was renamed the National Ocean Survey (NOS). This reorganization later included the transfer of the seismological and geomagnetic activities from NOS to the Environmental Research Laboratories (ERL), another mainline component of NOAA which is located in Boulder, Colorado, and the establishment within NOS of the Office of the National Geodetic Survey (NGS), the latter to include all geodetic functions of the former C&GS.

In 1973, the seismological and geomagnetic functions were transferred to the U. S. Geological Survey (USGS). However, the national data bank for geomagnetic data remained with NOAA and geomagnetic information is available from the National Geophysical and Solar-Terrestrial Data Center, EDS/NOAA, Boulder, Colorado 80302. The crustal movement studies which are performed by NGS will continue to be published and distributed by that office. Results of these studies and requests for geodetic data may be obtained from the Director, National Geodetic Survey Information Center, Rockville, Maryland 20852, Routing C18.

*This preprint is to be published in the NOAA NOS/NGS Technical Memorandum Series.

These organizational changes should have little effect on most users of geodetic control since these data will continue to be published and issued by the NGS. However, those surveyors and engineers who require information relating to seismic and magnetic data should refer their requests to the organizational components noted in the previous paragraph.

NGS will provide, upon request, price lists for the geodetic data and a selected group of publications. This information bulletin covers, in part, some of the material included in this paper, and in fact is perhaps more explanatory in some categories; but in general, its major content is directed to servicing procedures.

AVAILABILITY AND EXPLANATION

Publications

Most bound publications are printed and sold by the Superintendent of Documents, Government Printing Office, and all requests should be directed to that agency and not to the NGS. If, however, a publication cannot be furnished by the GPO, it occasionally may be obtained from NGS stock. The Department of Commerce also maintains Field Offices in most major cities, and these offices can usually furnish NGS publications in less time than that required to obtain them from the GPO.

During its long history, the Coast and Geodetic Survey prepared more than 300 Special Publications dealing with all of the scientific disciplines in which this Bureau was involved. Many of the older publications are out of print and in numerous instances will not be reprinted because the contents have been superseded by later publications or are of little present-day interest. The NGS does have file copies of those documents concerned with geodetic surveying and generally can furnish commercial-type copies of excerpts or occasionally even an entire publication; but such requests should be made only after receiving notification from the GPO that the publication is out of print.

The NGS, as in the past, will furnish data and is always available for advice concerning technical matters, such as specifications, use of theodolites and electronic distancing equipment, computations, review of unsatisfactory closures between points established by this agency, etc.

U. S. Depository Copy

Also available from NGS are numerous papers, technical bulletins, data reports, and similar pamphlet-type publications which have been prepared and issued over the years. Generally such material is limited in depth and scope but often appears in lists of references. For this reason, NGS has maintained a supply of the more popular ones and will reproduce a few copies of others upon request.

The reference library of any surveyor or engineer who performs control surveys or employs the State Coordinate Systems should contain the following NGS and ACSM publications and papers. All are included in the more comprehensive Bibliography which is given at the end of this paper, and for this reason, no further details other than the titles are given here.

(1) State plane coordinate projection tables for those states where projects would be undertaken.

(2) Tables of sines, cosines, and tangents (0° to 6°) for use in computing State coordinates on the Lambert system.

(3) The State Coordinate Systems (A Manual for Surveyors).

(4) Horizontal Control as Applied to Local Surveying Needs.

(5) Geodetic and Grid Angles - State Coordinate Systems.

(6) Classification, Standards of Accuracy, and General Specifications of Geodetic Control Surveys.

(7) Specifications to Support Classification, Standards of Accuracy, and General Specifications of Geodetic Control Surveys.

(8) Suggested Specifications for Local Horizontal Control Surveys.

(9) Standards and Specifications for Supplemental Horizontal Control Surveys.

(10) Definitions of Terms Used in Geodetic and Other Surveys.

(11) Electronic Distance Measuring Instruments.

The impression may be gained from a cursory review of the reference material that the use of the State Plane Coordinate System involves very complex procedures. Such is not really the case - in the final analysis, State plane coordinates are really nothing more than an adaptation of the latitude and departure practices which have been in use for centuries.

Numerous reasons have been given, during the last 40 years, for not employing the State Plane Coordinate Systems. Some are quite valid, a lack of national network control, for example; but others, especially those related to scale factors, hold little water. The application of a scale factor is an arithmetical process, not an involved mathematical procedure. In those higher elevation sections of the country, the reasons given for not using the system include the reduction to sea level in addition to scale factors. The sea level reduction is also an arithmetical manipulation, and in fact, the two factors can often be combined, thus resulting in but a single computation to reduce each measured distance.

Some surveyors and engineers contend the State systems are not adaptable to their projects because ground distances are required in laying out structures, etc. This problem, of course, can be generally overcome by projecting the State plane coordinates to the average elevation and correcting for the average scale factor of the site. In a few projects examined by the author, this has been a needless exercise since the distance measurements made at the site for construction purposes either involved such short lengths or such inaccurate taping procedures as to negate the requirement for project coordinates.

Horizontal Control Data

Early in the 1930's, it was decided to lithoprint horizontal and vertical control data in a loose-leaf form rather than in bound volumes by States as had been the general practice previously. For this format, which became known as the "lithos", separate listings for the geographic positions, plane coordinates by zones, and descriptions were required to complete the data for horizontal control points. Leveling data were issued by lines, and material involving several lines were often required to furnish the complete data for an area.

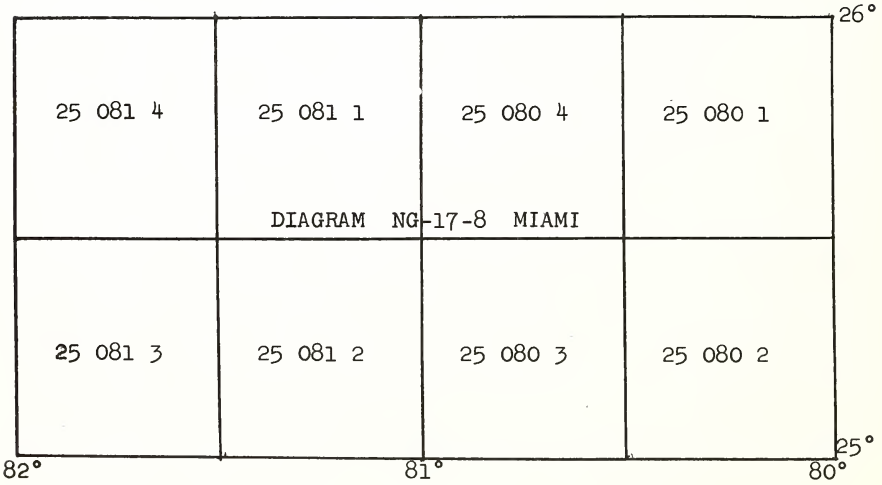
As time passed, a tremendous amount of data was accumulated and it became obvious that this format was cumbersome and that a new approach to publishing the material was mandatory. It was then decided to issue the data in 30' by 30' quads, the advantages being that all data for a horizontal control point could be printed on a single sheet of paper and all the leveling control for an area of about 800 square miles could be assembled in a single volume.

At this point in time, previously published adjusted geodetic data for most States have been converted to the quad format. With rare exceptions, all new adjusted data are being prepared in this form. The New Adjustment of the North American Datum presently underway is scheduled for completion in 1983. Published data for this adjustment will be computer generated probably similar to the quad format.

The diagrams for the quad format are on a 1:250,000 scale and show both horizontal and vertical control established by NGS, USGS, and any other Federal, State, or local government agencies whose data have been accepted for publication by NGS. The acceptance or adjustment of data published by NGS is made with the understanding that prescribed specifications for the stated standard of accuracy have been rigorously followed by the establishing agencies and this office (NGS) accepts no responsibility for the actual accuracy of these surveys.

Diagrams: The State diagrams showing control established and/or adjusted by NGS will continue to be published, one for the horizontal control and another for the vertical control (Figures 1 and 2). In those areas where the control is congested, larger-scale diagrams, such as nautical base charts, supplement the State diagrams.

The normal dimensions of the quad-format diagrams are 1° in latitude by 2° in longitude with the data assembled in 30' by 30' volumes. The horizontal and vertical control data are issued separately and designated as shown below:



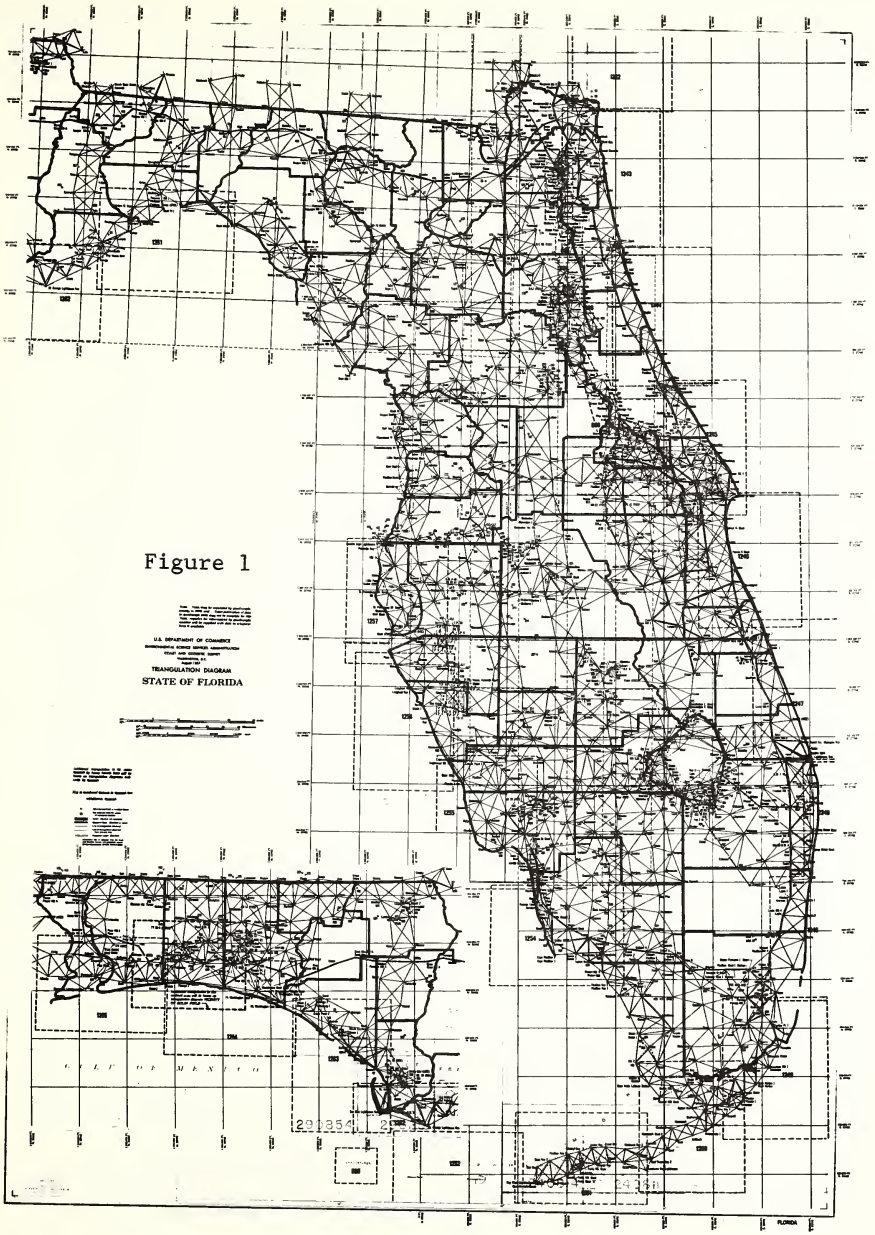

U.S. DEPARTMENT OF COMMERCE
TRIANGULATION DIAGRAM
STATE OF FLORIDA
GULF OF MEXICO
FLORIDA

Figure 1

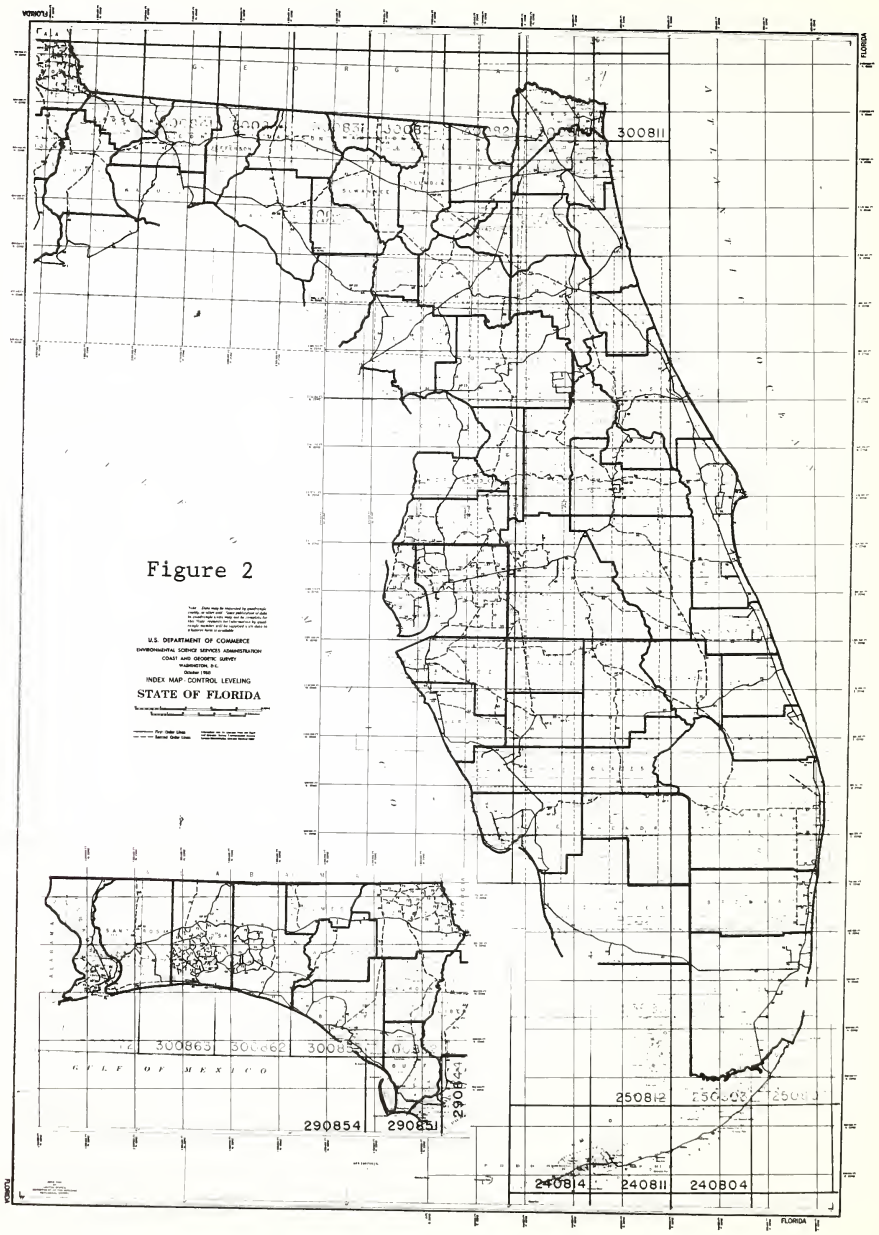


Figure 2
U.S. DEPARTMENT OF COMMERCE
ENVIRONMENTAL SCIENCE SERVICES ADMINISTRATION
COAST AND GEODETIC SURVEY
WASHINGTON, D.C.
October 1966
INDEX MAP - CONTROL LEVELING
STATE OF FLORIDA
300811
300863
300862
300861
290854
290851
290852
250812
240814
240811
240804
GULF OF MEXICO
FLORIDA

In a few instances along the coastlines the quad dimensions are 2° in latitude by 1° in longitude, and on other occasions to offset the need of an additional sheet, slightly larger than the normal size. Larger-scale base maps are also used to supplement the regular quad diagrams in those areas where a large concentration of control exists.

Control established or adjusted by the NGS is shown in black; that established, computed, and issued by the USGS in red; and data accepted by the NGS for publication in brown. The accuracy of the control is also indicated. A sample regular-size quad sheet is shown in Figure 3.

Data Sheet Format: An example of the new format horizontal-control data sheet is shown in Figure 4. This single-sheet type of listing replaces the multi-page tabulations previously employed. In the old "litho" format, as noted previously, separate sheets were necessary for the listings of the various data, and for the example shown in Figure 4, the user would have received as many as eight sheets of paper. Since much of the horizontal control data for a few States are still issued in the "litho" type format, examples and explanations of the data will be presented later.

The form shown in Figure 4 is largely self-explanatory. Nevertheless, it is thought the following comments are necessary to assure the user a more complete understanding of the tabulated data:

(1) Source - Archive number assigned to computations in which position was determined. Other source numbers are occasionally shown on data sheets which were prepared several years ago. These refer to projects in which the station was used as control, but this practice has been discontinued.

(2) Field Sketch - A sketch is drawn for each project and filed by State and number. Sketches for projects which extend into more than one State are assigned to one of the States involved. There are no hard or fast rules in this regard, however. Usually only the sketch for the project in which the station was originally positioned is shown. The field sketch number and locality are omitted on the more recent tabulations.

(3) Geodetic Positions -·Positions given to five decimal places of seconds are for computational purposes only and are not an indication of the accuracy of the point.

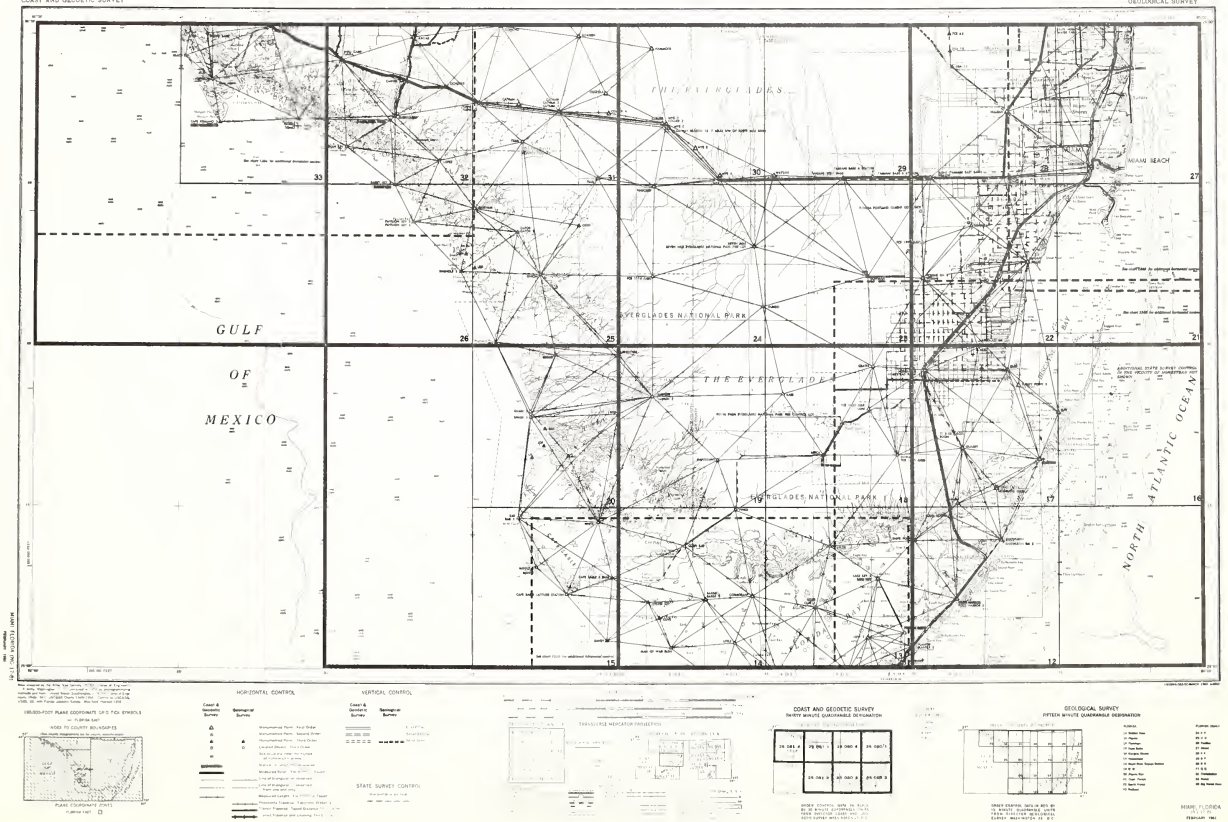

UNITED STATES
DEPARTMENT OF COMMERCE
COAST AND GEODETIC SURVEY
GEODETIC CONTROL DIAGRAM
UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
THE EVERGLADES
MIAMI BEACH
EVERGLADES NATIONAL PARK
GULF
OF
MEXICO
THE EVERGLADES
EVERGLADES NATIONAL PARK
NORTH ATLANTIC OCEAN
HORIZONTAL CONTROL
VERTICAL CONTROL
STATE SURVEY CONTROL
TRANSVERSE MERCATOR PROJECTION
COAST AND GEODETIC SURVEY
GEOLOGICAL SURVEY
FIFTEEN MINUTE QUADRANGLE DESIGNATION
INDEX TO COUNTY BOUNDARIES
PLANE COORDINATE ZONES
MIAMI, FLORIDA
1962

Figure 3

JANUARY 1969
U. S. DEPARTMENT OF COMMERCE
ENVIRONMENTAL SCIENCE SERVICES ADMINISTRATION
COAST AND GEODETIC SURVEY

HORIZONTAL CONTROL DATA

by the
Coast and Geodetic Survey
NORTH AMERICAN 1927 DATUM

QUAD 290813 STATION 1001
FLA
LATITUDE 29°00' TO 29°30'
LONGITUDE 81°30' TO 82°00'
DIAGRAM NH 17-8 DAYTONA BEACH

****

VOLUSIANA (Volusia County,Fla.,K.G.C.,1935)—This station is on Highway 19 about 1.4 miles E of the St. Johns River and about 5 miles W of Barberville. It is 30 meters N of the center of the highway, and 10 meters S of a woods road on property of Volusia Masonic Lodge No.77.

Surface, underground, reference and azimuth marks are standard bronze disks set in concrete as described in notes 1a, 7a and 11a.

Reference mark No.1 is NE of the station, reference mark No.3 is NW, both on N side of woods road. Reference mark No.2, the azimuth mark, is 0.25 mile W of the station, about 15 meters N of the center of the highway and in range with a concrete culvert.

To reach station from DeLand, Florida, go N on Highway 17 about 10 miles to Barberville and turn W on Highway 19. Go 4.8 miles and reach station on right side of road. Concrete culvert mentioned above is 0.25 mile further down the road.

OBJECT		DISTANCE	DIRECTION
GROVE			0°00'00"0
R.M.No.1		134.41 feet	61 51 08
R.M.No.2	Az.Mk.	0.25 mile	300 39 25
R.M.No.3		168.16 feet	337 48 18
R.M.No.1 to R.M.No.3		204.09 feet	

Height of light above station mark - 38 meters.
Height of telescope above station mark - 36 meters.

VOLUSIANA (Volusia County,Fla.,K.G.C.,1935;H.A.P.,1935)—Recovered by the field inspection party. Station found in good condition. Description adequate.

VOLUSIANA (Volusia County,Fla.,K.G.C.,1935;L.D.G.,1938)—Station recovered as described, in good condition.

RECOVERY NOTE, TRIANGULATION STATION

R

NAME OF STATION: VOLUSIANA
ESTABLISHED BY: K.G.C. YEAR: 1935 STATE: Florida BENCH MARK(S) ALSO ☐
RECOVERED BY: V.R.S. YEAR: 1963 COUNTY: Volusia
AIRLINE DISTANCE AND DIRECTION FROM NEAREST TOWN:

Detailed statement as to the fitness of the original description; including marks found, stampings, changes made, and other pertinent facts:

Station was searched for but not recovered. The area of the azimuth mark is clear off and is part of a new subdivision.

U.S. DEPARTMENT OF COMMERCE
COAST AND GEODETIC SURVEY

R

RECOVERY NOTE, TRIANGULATION STATION

NAME OF STATION: VOLUSIANA
ESTABLISHED BY: K.G.C. YEAR: 1935 STATE: Florida
RECOVERED BY:* L.M. Chase YEAR: 1968 COUNTY: Volusia

HEIGHT OF TELESCOPE ABOVE STATION MARK 35 METERS, HEIGHT OF LIGHT ABOVE STATION MARK 38 METERS.

DISTANCES AND DIRECTIONS TO AZIMUTH MARK, REFERENCE MARKS AND PROMINENT OBJECTS WHICH CAN BE SEEN FROM THE GROUND AT THE STATION

OBJECT	BEARING	DISTANCE FEET	DISTANCE METERS	DIRECTION ° ' "
HINSON 1935				00 00 00.0
RM 4	SW	313.43	95.535	61 22 41.3
RM 3	NW	168.18	51.265	123 36 21
RM 1	NE	134.39	40.962	207 39 24
RM 1 to RM 3		204.10	62.213	

Station and all marks were recovered and found in good condition. Reference mark 4 was established at this time. Azimuth mark is no longer visible from the ground. The distance and direction to the reference marks checked with the original description. Due to various changes, a complete new description follows.

The station is located about 15 miles northwest of DeLand, 5 miles west of Barberville, 1 1/2 miles east of the St. Johns River and on property of Mr. Orval H. Lycan of Ashland, Kentucky.

ADJUSTED HORIZONTAL CONTROL DATA

NAME OF STATION: VOLUSIANA
STATE: FLORIDA YEAR: 1935 FIRST ORDER
LOCALITY: ST JOHNS RIVER
SOURCE: G-3606 FIELD SKETCH: FLA 211

GEODETIC LATITUDE	29 10 13.93255	ELEVATION:	8.3 METERS
GEODETIC LONGITUDE:	81 30 01.82028		27 FEET

STATE COORDINATES (Fee)				
STATE & ZONE	CODE	X	Y	∠ FOR Δ α ANGLE
FLA. W.	0902	659,410.80	1,758,565.62	+ 0 14 37
FLA. E.	0901	340,266.46	1,758,566.99	- 0 14 38

TO STATION OR OBJECT	GEODETIC AZIMUTH (From south)	PLANE AZIMUTH (From south)	CODE
HINSON	0 33 32.7	0 18 56	0902
HINSON	0 33 32.7	0 48 11	0901
AZIMUTH MARK RM 2	87 01 05.5	86 46 28	0902
AZIMUTH MARK RM 2	87 01 05.5	87 15 44	0901

To reach the station from the junction of U.S. Highway 17 and State Highway 40 in Barberville, go southwest and westerly on State Highway 40 for 4.9 miles to a triangle blazed power line pole on left, a triangle blazed pine tree and station on right as described. Station mark, stamped VOLUSIANA 1935, projects about 6 inches. It is about 230 feet northeast of a triangle blazed power line pole, 104.5 feet north of center of highway, 99.5 feet northeast of a triangle blazed pine tree and 22 feet north of a triangle blazed pine tree. (Note 1a 7a)

RM 1, stamped VOLUSIANA NO 1 1935, projects about 5 inches. It ie 10 feet northwest of a 6-inch pine tree, 8 feet west of a 4-inch pine tree and 1.4 feet southwest of a metal witness post. (Note 11a)

RM 3, stamped VOLUSIANA NO 3 1935, projects about 6 inches. It is 8 feet northeast of a 7-inch pine tree and 1.5 feet southeast of a metal witness post. (Note 11a)

RM 4, stamped VOLUSIANA NO 4 1935 1968, projects about 3 inches. It ie 38.5 feet south of center of highway, 34 feet southwest of power line pole number R2AA624, 4.5 feet southwest of a small pine tree and 1.5 feet south of a metal witness post. (Note 11b)

RM 2 AZ MK, stamped VOLUSIANA NO 2 1935, projects about 5 inches. It is 54 feet north of center of highway, 38 feet north of north end of concrete culvert, 19.3 feet northwest of a "Fishing Camp" sign and 6.5 feet southwest of a triangle blazed pine tree.(Note 11a)

To reach the AZ MK from station, go west on State Highway 40 for 0.25 mile to mark on right as described.

All marks are standard disks set in concrete posts.

Robert P. Tomaly

*Name of chief of party should be inserted here. The officer who actually visited the station should sign his name at the end of the recovery note.

NOTE - One of these forms must be used for every station recovered.

Figure 4

(4) Elevations - Values shown to one decimal in meters and to even feet were probably determined from vertical angles (trigonometric leveling). Elevations given to two decimals in meters and one decimal in feet were generally determined in the course of a leveling project or from a spur line run by the horizontal control party from nearby bench marks. Elevations determined in such spur leveling usually carry the notation "WYE LEVELING." Those which have no check are so indicated and the source of the data, if other than the NGS, is also noted. Due to policy changes remarks concerning the elevations are not always shown on the latest listings.

A few words of caution must be offered with respect to these values. Vertical angle elevations can be $\pm$ 3 feet or more in error relative to leveling control in the general area and many of those elevations shown to two decimals in meters are unadjusted values. The principal reasons for tabulating these data are for use in reducing electronic distance measurements and to furnish elevation control for those projects where accuracy is not critical.

Whenever a project involves the need for accurate elevations, the State or quad diagrams should be examined to ascertain the availability of leveling control in the immediate area and then a request made to the appropriate agency for the data.

(5) State Coordinates - The "X" coordinate is the value in feet which is referenced east or west of a selected meridian which has been designated as the central meridian for a particular zone. In order to keep the coordinates positive, a large constant value is assigned to the central meridian and in the State system the computed coordinate (X') is added to this constant value when the point is east of the central meridian and subtracted when west of this meridian. For the example shown, the central meridians for both zones have assigned values of 500,000.00 feet. The station is therefore 159,410.80 feet east of the central meridian for the west zone and 159,733.54 feet west of the east zone central meridian.

The "Y" coordinate is the distance in feet north of some parallel of latitude which is below the southernmost extremity of the zone and generally assigned a numerical value in feet of 0.00.

(6) θ (or $\Delta\alpha$ angle) - The angle between the geodetic and grid meridian and often referred to as the mapping angle.

These angles are applied with the opposite sign to geodetic or astronomic azimuths to obtain plane (grid) azimuths. In this example, the coordinates are computed on the transverse Mercator projection and the mapping angles are identified as $\Delta\alpha$ (delta alpha) angles. Similar values on the Lambert projection are referred to as θ (theta) angles. Another term, the (t-T) or second term correction may be computed and applied as an additional refinement, but generally it is quite small and usually can be ignored. However, the computations are rather simple (see reference no. 5, page 4) and where significant, they should be applied to the azimuths and angles in those projects where a high accuracy is required.

Astronomic azimuths should also be corrected for the deflection of the vertical at the point of observation when such azimuths are to control higher grade projects. This correction is known as the Laplace correction and can amount to as much as 20" in the conterminous United States, but generally is considerably smaller. Values of 5 to 7" are not uncommon, however. The NGS will furnish estimated corrections upon request. Since these estimations involve, in many cases, a review of the local topography, reasonably accurate positions of the points from which the observations were made are required. Scaled values from USGS topographic sheets are usually satisfactory for this purpose.

(7) Geodetic and Plane Azimuths - For the more recent listings, the number of azimuths listed is limited to those required to compute the azimuths of the marks and objects given in that portion of the description or recovery notes known as the "box" or "box score". In earlier versions, all geodetic azimuths and distances from the station were shown, but the revisions of these data necessary to keep the listings up-to-date became too much of a costly burden and the practice was discontinued. It was felt that with the availability of electronic computers, these data could be easily computed and their elimination from the format would cause little inconvenience.

(8) Descriptions and Recovery Notes - Anyone using a station to control a survey should verify the descriptive and observational data contained therein to insure that a recovery has been made. Any discrepancies should be reported to the NGS or the establishing agency if the data were not obtained from NGS.

The "DIRECTION" shown in the box does not refer to a compass bearing but to the angular direction from the initial point taken in a clockwise manner. The direction to the initial point is usually assigned a value of 0° 00' 00".0.

The angles between any of the other points are obtained by differencing the directions involved. All points shown in the box, with the possible exception of the initial point, were visible at tripod height at the time the descriptive information was prepared. When the initial station carries the notation VG (visible from ground), it too can be observed from tripod height.

(9) Additional Explanatory Notes - When a point has been determined by procedures which do not provide a check, the notation "NO OBSERVATIONAL CHECK ON THIS POSITION" appears under the Source. The agency making the observations, if other than the NGS, is identified by the statement "Observations by _____" which immediately follows the station name. Other appropriate comments are added below the azimuths when considered necessary to explain particular circumstances. In general, only the date of establishment is shown but on occasion, especially in crustal movement areas where new positions have been determined, the original date and date of the new observations used in the new position determination are noted.

"Litho" Type Format: The old style horizontal control listings, commonly called "lithos", involve, as noted previously, separate sheets for the geographic positions, plane coordinates, descriptions and recovery notes (see Figures 5, 6, and 7). There were some advantages to this format such as the availability of all geodetic azimuths and lengths and the data were assembled in a more orderly fashion with regard to the actual route of the survey and the area covered; but these advantages were more than offset by the numerous sheets of paper that were required to complete the compilation of the data for a point.

In the early forms used for this type of listing there were other disadvantages; the order of accuracy, for example, was not indicated but generally it could be ascertained by a review of the data as follows:

DEPARTMENT OF COMMERCE
U. S. COAST AND GEODETIC SURVEY
Form 28 B

GEOGRAPHIC POSITIONS

475
Accession No. of Computation: GULF

Locality Colquitt, Ga. to Mobile, Ala. Datum North American 1927 State Florida

STATION	LATITUDE AND LONGITUDE	SECONDS IN METERS	AZIMUTH	BACK AZIMUTH	TO STATION	DISTANCE		
						LOGARITHM (METERS)	METERS	FEET
Chumuckla, 1938 (d.m.)	30 45 03.891		133 32 05.07	313 27 37.06	McDavid	4.282716 3	19174.16	62907.2
	87 11 44.128		190 16 11.18	10 16 55.60	New York	4.111374 7	12923.34	42399.3
			357 17 37.9		Azimuth mark			
Barth, 1938 (d.m.)	30 45 20.805		181 50 41.99	1 50 49.86	McDavid	4.103248 0	12683.76	41613.3
	87 20 42.753		233 41 25.33	53 46 45.64	New York	4.314217 1	20616.60	67639.6
			272 02 38.07	92 07 13.49	Chumuckla	4.156414 7	14335.56	47032.6
			16 32 25.3		Azimuth mark			
Quintette, 1938 (d.m.)	30 39 28.331	(Bench Mark*)	171 37 37.92	351 37 07.25	Barth	4.040259 8	10971.34	35995.1
	87 19 42.687		230 54 33.54	50 58 37.90	Chumuckla	4.214842 3	16399.94	53805.5
			320 59 22.25	141 03 02.01	Escambia	4.262149 5	18287.30	59997.6
			24 47 59.66	204 46 08.84	Hurst	4.140925 7	13833.30	45384.8
			270 45 28.4		Azimuth mark			
Pace, 1938 (d.m.)	30 39 18.959		10 40 14.13	190 39 24.03	Escambia	4.151432 9	14172.06	46496.2
	87 10 52.458		91 12 31.62	271 08 01.26	Quintette	4.149829 4	14119.83	46324.8
			125 23 33.34	305 18 31.92	Barth	4.284134 6	19259.04	63185.7
			172 37 40.09	352 37 13.71	Chumuckla	4.029817 1	10710.68	35140.0
			356 55 22.4		Azimuth mark			
Cantonment, 1938 (d.m.)	30 36 46.139	(Bench Mark*)	40 32 20.21	220 30 16.77	Hurst	3.997871 3	9951.24	32648.4
	87 19 17.717		172 25 05.82	352 24 53.10	Quintette	3.702315 8	5038.67	16531.0
			250 41 12.65	70 45 30.11	Pace	4.153949 3	14254.41	46766.3
			310 21 21.67	130 24 48.59	Escambia	4.153271 8	14232.26	46693.7
			158 11 29.5		Azimuth mark			
Oak Grove, 1938 (d.m.)	30 53 53.936		226 46 42.13	46 50 31.70	Flomaton	4.210913 7	16252.26	53321.0
	87 25 01.627		293 11 53.97	113 14 14.74	McDavid	3.899070 9	7926.31	26004.9
			121 24 59.8		Azimuth mark			

*Bench Mark=Elevation determined by spirit leveling.

Figure 5

DEPARTMENT OF COMMERCE
U. S. COAST AND GEODETIC SURVEY
Form No. 1068
Rev. Sept. 1938

PLANE COORDINATES Rev.8/55; 10/57

State Florida Locality Colquitt,Ga. to Mobile,Ala. North American 1927 datum. Projection Lambert Zone North

Station	x Coordinate / y Coordinate	Plane azimuth	Mark	Station	x Coordinate / y Coordinate	Plane azimuth	Mark
	Feet	° ′ ″			Feet	° ′ ″	
Pocosin,1938, r'45	1,316,233.44	139 47 43 *	Azimuth Mark	Jay,(Fla.),1938, r'44	1,168,939.91	326 19 42 *	Azimuth Mark
(d.m.)	592,606.84			(d.m.)	731,361.14		
Rock Creek,(Fla.-Ala), 1938, r.'50	1,285,747.01	200 59 31 *	Azimuth Mark	Santa,(Fla.),1938,	1,180,895.79	278 14 43 *	Azimuth Mark
(d.m.)	733,320.35	270 43 54 * Az. Mark, 1950		(d.m.)	719,296.41		
Otahitaa,(Fla.),1938, r.'50	1,284,787.33	346 22 01 *	Azimuth Mark	New York,(Fla.),1938,	1,161,799.56	99 35 06 *	Azimuth Mark
(d.m.)	693,153.30			(d.m.)	688,353.03		
Munson,(Fla.),1938, r.'50	1,256,820.62	271 53 01 *	Azimuth Mark	Flomaton,(Ala.),1938, r'44	1,124,833.18	274 33 50 *	Azimuth Mark
(d.m.)	694,588.33			(d.m.)	732,581.67		
Alaflora,(Fla.-Ala.) 1938,	1,263,721.46	207 24 58 *	Azimuth Mark	McDavid,(Fla.), 1938,	1,108,687.17	280 15 45 *	Azimuth Mark
(d.m.)	733,902.07			(d.m.)	691,219.02		
Juniper,(Fla.)1938,	1,235,857.74	308 04 00 *	Azimuth Mark	Chumuckla, 1938,	1,153,256.13	358 38 54 *	Azimuth Mark
(d.m.)	700,369.98			(d.m.)	646,822.85		
Camp,(Fla.-Ala.),1938,	1,228,045.53	176 53 25 *	Azimuth Mark	Parth, 1938,	1,106,309.98	17 58 12 *	Azimuth Mark
(d.m.)	735,801.03			(d.m.)	649,672.16		
Barry,(Fla.), 1938,	1,200,145.54	30 03 09 *	Azimuth Mark	Quintette,1938,	1,110,666.38	272 10 46 *	Azimuth Mark
(d.m.)	695,094.75			(d.m.)	613,942.83		
Dixon,(Fla.-Ala.),1938,	1,205,577.19	21 49 00 *	Azimuth Mark	Pace, 1938,	1,156,944.38	358 16 13 *	Azimuth Mark
(d.m.)	735,827.75			(d.m.)	611,877.30		

1 No check on this position. * This azimuth has been computed by the θ formula neglecting the second term. ** This azimuth has been computed by the θ formula using both terms.

U. S. GOVERNMENT PRINTING OFFICE 123847

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Figure 6

UNITED STATES COAST AND GEODETIC SURVEY
Descriptions of Triangulation Stations

Shedy to Lily, Florida.

WOODS (Marion County,Fla.,H.C.W.,1933)--This station is about 4.5 miles S of the courthouse in Ocala, and about 250 yards W of the Orange Avenue macadam road, on land owned by W.E. Woods, who lives about 0.2 mile S of the W side of the road. The station is on enclosed timber land, about 200 yards W of a partly built rock foundation, on which Mr. Woods intends to build a house. It is on the highest part of the hill, about 75 yards N of the edge of the cleared, cultivated land. The station is 41 feet W of a blazed oak tree, and the mark projects 8 inches.

Surface, underground, reference and azimuth marks are standard bronze disks set in concrete as described in notes 1a, 7a, and 11a.

Reference mark No.1 is ESE of the station, 10 feet from the road leading to the station and 13 feet WNW of a pine tree which is slightly to the right of an extension of the line between the station and the reference mark. The mark projects 8 inches.

Reference mark No.2 is SW of the station, and about 30 feet from the edge of the clearing. The mark projects 8 inches.

The azimuth mark is N of the station, 33 feet E of the center line of the Orange Avenue road, and projects 8 inches. The mark is 0.4 mile N of the entrance to the station, and 2.2 miles S of the point where the turn into Orange Avenue is made.

To reach from the courthouse in Ocala, go S 1.8 miles to the Orange Avenue cross road, turn right (S) and go 2.6 miles to the rock foundation mentioned above. Turn in here and follow the dim road around the foundation to the top of the hill, and the station.

A 116-foot tower was erected first, but tha line to HANTEL was obstructed by a ridge about 1/2 mile W. A 136-foot tower was necessary to clear the line.

OBJECT	DISTANCE	DIRECTION
HOTEL	feet	°°°°°°°
R.M.No.1	134.72	81 50 55.4
R.M.No.2	129.68	182 43 11.2
Az.Mk. (Approx.)	0.4 mile	340 54 28.2

****

LUCIUS (Marion County,Fla.,H.C.W.,1933)--This station is about 11 miles S of Ocala, 3.7 miles by road SW of the Belleview railroad station, 0.2 mile N of the macadam road leading from Belleview SW to the Orange Avenue macadam road, on the highest point of a hill, in open timbar land and on property which has been taken over by the State for taxes. The mark is about 250 paces E of the farmhouse owned by Mr. C.E. Lucius, 276 feet E of the private road leading from the highway to the farmhouse, 22 feet SE of an oak tree marked with a triangular blaze and 19 feet NE of a large charred stump. The mark projects 5 inches above the ground.

Surface, underground, reference and azimuth marks are standard bronze disks set in concrete as described in notes 1a, 7a and 11a.

Reference mark No.1 is N of the station, 96 feet E of the private road and projects 12 inches above the ground.

Reference mark No.2 is S of the station and projects 12 inches above the ground.

The azimuth mark is 0.15 mile S of the station, 36 feet N of the center line of the macadam road, 27 feet W of a concrete culvert and projects 12 inches above the ground.

To reach from Ocala follow U.S. Highway 441 S about 3 miles to the junction with a macadam road called Orange Avenue. This is about 0.3 mile S of a Seaboard Airline Railroad underpass. At the junction there is a filling station on either side of U.S. Highway 441. Turn right and follow Orange Avenue 9.4 miles to crossroads. A macadam road leads E and a graded sand road W. Turn E and follow the macedam road 2.5 miles to the private road leading N to the Lucius's home. Follow this road N 0.2 mile to e blazed oak tree at the point where the road swings sharp left. Turn right and go 276 feet to the station.

OBJECT	DISTANCE	DIRECTION
WHITE	feet	°°°°°°°
R.M.No.2	180.00	22 31 42.2
Large White Bldg.(S)	2.5 miles	228 26
R.M.No.1	144.09	273 53 21.9
Az.Mk. (Approx.)	0.15 mile	273 46 57.6
Unpainted bungalow (S)	0.2 mile	117 13

Reight of telescope above station mark - 116 feet.

LUCIUS (Marion County,Fla.,H.C.W.,1933;J.S.B.,1936)--Station mark, reference and azimuth marks recovered in good condition.

Reference mark No.1 is S of the station instead of N as originally described.

Reference mark No.2 is W of the station instead of S as originally described.

The azimuth mark is S of the station as described.

There is an error in mileage in describing how to reach the station from Ocala. It should be made to read as follows:

To reach from Ocala, follow U.S. Highway 441 S about 2.0 miles or 0.2 mile S of the Seaboord Airline Railroad underpass to road forks at a filling station on either side of U.S. 441. Here U.S. 441 bears left and a macadam road called Orange Avenue turns right (S). Turn right and follow Orenge Avenue 9.4 miles to crossroads. A macedam road leads E and a greded sand road W. Turn E and follow the macadam road 2.5 miles to the private road leading N to the Lucius' home. Follow this road N 0.2 mile to a blazed oak tree at the point where the road swings sharp left. Turn right and go 276 feet to the station.

LUCIUS (Marion County,Fla.,H.C.W.,1933;E.B.L.,1937)--Station was recovered approximotely as described. Marks in good condition and undisturbed. Corrected description as follows:

About 11 miles S of Ocala, 3.5 miles SW of Belleview, 0.2 mile N of the macadam road leading W from Belleview (at junctions of U.S. Highways 441 and Florida 23) to Orange Ave. At the highest point of a smell hill, in open timber land which has been taken for taxes. The mark is 200 yards E by N of C.E. Lucius' home. 270 feet ENE of sand road leading to the Lucius home. 19 feet N of a fire blackened stump, 3 feet high, 22 feet SE of an oak trea marked with a trianguler blaze. Mark, note 1b, projects 5 inches.

Reference mark No.1 is S of station, note 11b, and projects 10 inches.

Reference mark No.2 is a standard disk set in concrete as described in note 11b, is W of the station, 30 yards E of the center line of the sand road. It projects 12 inches.

OBJECT	DISTANCE	DIRECTION
WOODS	feet	°°°°°°°
R.M.No.1 (S)	114.06	197 57 45.
R.M.No.2 (W)	180.05	306 35 56.

****

WHITE (Marion County,Fla.,H.C.W.,1933)--This station is about 13 miles SSW of Ocala, in open timber land and on the highest point of a ridge.

Surface, underground, reference and azimuth marks are standard bronze disks set in concrete as described in notes 1a, 7a and 11e.

Reference mark No.2 is N of the station and projects 7 inches.

Reference mark No.1 is SW of the station and projects 8 inches.

The azimuth mark is about 0.2 mile N of the station, 174 paces SE of the two blazed trees marking the trail, 37 paces S of the sand road and projects 10 inches above the ground.

To reach from Ocala follow U.S. Highway 441 to the intersection with Orange Avenue, which is about 0.2 mile S of the Seaboard Airline railroad underpass. Follow Orange Avenue S 10.4 miles to Danks Corner. There is en old church on the W side of the high-, way and a small store on the E side. Turn W on a sand road and go 1.1 miles to a road leading SW through the woods; there is a cross road at 1.0 mile. Follow the road SW 0.7 mile to a E-W road at the SE corner of a cleared field and wire fence. Turn W and go 2.7 miles to two blazed trees on the S side of the road. One tree is a pine and the other is an oak. Turn S and follow the blazed trail 0.25 mile to the station on the ridge. The mark is 24 fast SW of a blazed pine tree, 18 feet S of a 10-foot stump, 30 feet N of e leaning oak tree and projects 6 inches above the ground.

OBJECT	DISTANCE	DIRECTION
STOKES	feet	°°°°°°°
R.M.No.2	178.62	43 33 24.0
R.M.No.1	199.72	292 46 48.8
Az.Mk. (Approx.)	0.2 mile	68 48 28.9

Height of telescope above station mark - 116 feet.

WHITE (Marion County,Fla.,H.C.W.,1933;J.S.B.,1936)--All marks recovered as described in good condition.

WHITE (Marion County,Fla.,H.C.W.,1933;E.B.L.,1937)--Station, reference and azimuth marks recovered as described and in good condition.

****

TURNER (Citrus County,Fla..O.L.A.,1934)--Station is in clearing on W side of Withlacoochee River, and about 0.5 mile N of Turners Camp. It is 121 feet W of road, 165 feet W of prominent palmetto on high-water line on W bank of river, 170 feet S of edge of live oaks. Mark projects 3 inches.

Surface, underground, reference and azimuth marks are standard bronze disks set in top of concrete as described in notes 1b, 7e and 11b.

Reference mark No.1 is 7.5 feet E of road, 93 feet W of high-weter line, 52 feet S of palmetto. Mark projects 3 inches.

Reference mark No.2 is 9.5 feet S of fence, 8 feet E edge of clearing, 102 feet W of road at entrance to woods, 146 feet W of high-water line, and projects 6 inches.

Azimuth mark is 3 feet NW of wire fence, 8 feet SW of 12-inch oak, 55 feet WE of 12-inch dead gum tree in fence corner, 150 feet E of road, and projects 4 inches.

To reach from courthouse in Inversmess, go NW on U.S. Highway 41 (twin street) 0.65 mile; turn right on paved street and follow macadam road to its end and continue on sand road, following main-travelled way for a totel distance of 7.7 miles to Turner's Camp on Withlacooche River. Just before entering camp turn left at leaning pine tree and follow dim trail through fenced lane for 0.5 mile to clearing on left and station.

OBJECT	DISTANCE	DIRECTION
CHASSA	feet	°°°°°°°
R.M.No.2 (N)	168.26	79 22 12.7
R.M.No.1 (ESE)	152.56	220 01 48.4
Az.Mk. (SSE)	0.15 mile	254 02 34.6

A 126-foot towar saw stetions CASSA and LIVEOAK, but failad to see LEGANTO.

TURNER (Citrus County,Fla.,G.L.A.,1934;E.B.L.,1937)--Station and all marks recovered as described and in good condition. Additional description follows:

Stotion is on the W shore of the Withlacoochee Rivar, near the N tip of a small triangular clearing, on a slight rise at the N end of a double row of palmettoes, 60 feet N of the taller of two oak trees, 62 feet W of a 4-foot burned out snag, about 55 yerds E of edge of river swamp, about 90 yards W of the high-wetor line of W bonk of river. Mark projects 4 inches.

****

WILDWOOD (Sumter County,Fla.,E.B.L.,1937)--Station is about 2.7 miles by road NNW of Wildwood, near the house of and on timber land owned by Mr. Caruthers. Mark is 22 feet E of center line of woods road and 22 feet SW of triangular blaze on 22-inch pine. It projects 2 inches.

Surface, underground, reference and azimuth marks are standard bronze disks set in concrete as described in notes 1a, 7a and 11a.

Reference mark No.1 is located NW of the station, 6 feet SSE of a 20-inch pine, and 17 paces W of the center line of the woods road. It projects 4 inches.

Reference mark No.2 lies S of the station, 10 yards E of the center line of the woods road and 8 feet ESE of a 16-inch pine tree. It projects 4 inches.

Azimuth mark lies on the dirt road 0.45 mile W of the lane leading to the Caruthers dwelling. The mark is 8 yards N of the center line of the road and 65 yards E of a sand creaa road. It is 45 yards NNE of a small pond and projects 6 inches.

To reach station from junction of Route 36 and 44A in Wildwood go W on Route 36, 2.2 miles to a sand T-road going N. Turn N and go 0.45 mile to point where road turns W, continua N past Caruthers dwelling and through gate into woods. Station liaa 95 yards N of gate on E side of woods road.

OBJECT	DISTANCE	DIRECTION
SUMPTER	feet	°°°°°°°
R.M.No.2	90.22	97 17 39
Az.Mk. (Approx.)	0.5 mile	72 24 54.8
R.M.No.1	91.69	128 00 48

Reight of light above station mark - 34.7 meters.
Reight of telescope above station mark - 31 meters.

****

Figure 7

First-order - azimuths to hundredths of seconds, logarithms of the distances in meters to seven places, and the distance in meters to two decimal places.

Second-order - azimuths, logarithms, and distances to one less decimal or significant figure than for first-order points. Since surveys made to third-order accuracy were also listed in the same manner, it is occasionally difficult to determine the accuracy of a particular point. Any problems which may arise in this regard would generally be in the coastal regions because units other than geodetic parties may have performed the surveys.

Geodetic parties seldom, if ever, perform surveys to less than second-order specifications, except to locate certain structures. But photogrammetric or hydrographic support units often establish control only to the accuracy required for the particular project involved and these accuracies may be third-order or even less on occasion. Data for surveys made to less than third-order requirements are not published, however.

In those cases when the accuracy of the control is an important consideration in a project requirement and there are any doubts whatsoever in this regard, the NGS should be consulted prior to beginning field operations. A further discussion of the accuracy of the control will be made later.

Intersection points such as water tanks, church spires, etc., with very rare exceptions are always located to third-order accuracy. No check points in this listing format are given to hundredths of seconds in position and to even feet for the State plane coordinates.

Field Positions: At the conclusion of a field project, lists of geographic positions computed from the unadjusted observations and lists of descriptions and recovery notes are prepared and published. The listing format is very similar to the "litho" type and all the data are printed on yellow colored paper (Figures 8 and 9).

These positions must be employed with care since the values, regardless of the number of decimal places shown, have not been processed in any manner to remove or distribute the closures other than those involved in the triangles. The general practice is to initiate the computations from one published line and proceed in a continuous operation without

FORM C&GS-28D (12-65)

U.S. DEPARTMENT COMMERCE
COAST AND GEODETIC SURVEY
ESSA

FIELD GEOGRAPHIC POSITIONS

G-14639

7.

LOCALITY Palm Beach County

Class 1
NORTH AMERICAN 1927 DATUM First - ORDER TRIANGULATION. STATE Florida

STATION	LATITUDE AND LONGITUDE	AZIMUTH	BACK AZIMUTH	TO STATION	DISTANCE METERS
CALJUD 1970	26 44 42.5166	135 56 16.57	315 54 50.48	SUITER	7,591.887
d.m.	80 18 25.7998	249 43 54.74	69 45 34.55	SHINER	6,529.811
		21 57 25.8		AZ MK	
TWENTY MILE 1953	26 41 10.5633	192 51 08.95	12 51 53.47	SUITER	12,285.560
r.'70 d.m.	80 23 15.8841	230 51 05.37	50 53 15.78	CALJUD	10,336.337
		274 08 48.7		AZ MK	
2ND TWENTY MILE 1953	26 41 10.5640	272 21 14.33	92 23 18.16	EARL	7,630.039
	80 23 15.8843	311 43 24.41	131 46 31.71	PUMP	15,486.214
LEVEE 1970	26 38 03.5854	202 50 14.71	22 50 51.88	EARL	5,901.627
d.m.	80 20 02.9928	306 12 59.79	126 14 40.51	PUMP	7,710.932
		307 22 52.3		AZ MK	
2ND CONVICT 1934	26 32 56.3639	126 33 47.06	306 32 00.27	PUMP	8,224.213
	80 12 19.4272	179 32 57.05	359 32 56.14	AMERICAN	7,118.016
COW 1970	26 39 05.6116	226 02 03.89	46 02 58.11	FERGAN 2	4,640.792
d.m.	80 14 08.1472	325 11 31.55	145 12 19.38	AMERICAN	5,170.982
		90 53 57.8		AZ MK	
BOLA 1970	26 50 25.1772	224 58 42.32	45 01 48.87	APIX	16,096.292
d.m.	80 27 57.6170	295 49 06.73	115 51 58.47	SUITER	11,680.720
		134 30 26.1		AZ MK	
2ND GREEN 1970	26 42 29.3991	318 25 44.67	138 26 28.62	FERGAN 2	4,077.037
	80 13 45.1829	57 57 55.05	237 56 44.93	HATCHEE	5,090.125
TERRY 1970	26 44 22.1283	239 56 00.99	59 58 52.41	SUITER	12,147.935
d.m.	80 27 57.5712	307 06 55.04	127 09 01.66	TWENTY MILE	9,766.370
		130 30 49.8		AZ MK	

Figure 8

[1]No check on this position.

Abbreviations used: d.=described; m.=marked; n. =not; r.=recovered; l.=lost; p.=probably.
(Examples: n.d.=not described; p. l.=probably lost.)

USCOMM-DC 36340-P65

COMP: JHM
CHK: HWK

U. S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

UNADJUSTED HORIZONTAL CONTROL DATA

by the
Coast and Geodetic Survey
NORTH AMERICAN 1927 DATUM

G-

FORM 525
(8-67-P)

U.S. DEPARTMENT OF COMMERCE
COAST AND GEODETIC SURVEY

QUAD. 260801

DESCRIPTION OF TRIANGULATION STATION

NAME OF STATION: CALJUD
STATE: Florida
COUNTY: Palm Beach
CHIEF OF PARTY: C.L. Hardt
YEAR: 1970
DESCRIBED BY: C.W. Wright

NOTE - HEIGHT OF TELESCOPE ABOVE STATION MARK 23 METERS. HEIGHT OF LIGHT ABOVE STATION MARK 26 METERS.

	SURFACE-STATION MARK, UNDERGROUND-STATION MARK	DISTANCES AND DIRECTIONS TO AZIMUTH MARK, REFERENCE MARKS AND PROMINENT OBJECTS WHICH CAN BE SEEN FROM THE GROUND AT THE STATION				
			DISTANCE		DIRECTION	
	OBJECT	BEARING	FEET	METERS		
					° ′ ″	
	SHINER				00 00 00.0	
11b	RM 1	SE	81.92	24.970	49 26 37	
16b	AZ MK	S	(0.55 mile)		112 13 31.1*	
11b	RM 2	W	73.52	22.407	201 21 52	
	Loxahatchee Callery-Judge Rad					
	2.4Y 552 Mast (Approximate Cent)	NW	57.87	17.639	241 17 24	
	RM 1 to RM 2		150.79	(45.961)		

Description

Station is located about 16 miles west-northwest of the center of West Palm Beach, 10 miles west of the Sunshine State Parkway, 5 miles northwest of Loxahatchee, 4 1/2 miles north of U.S. Highways 98 and 441 and on property owned by Callery-Judge Groves.

To reach the station from the Loxahatchee Post Office go west on U. S. Highways 98 and 441 for 2 miles to buildings on right and a sand road right. Turn right and go north on sand road for 4.0 miles to the Azimuth mark on the right. Continue north on sand road for 0.55 mile to the office of Callery-Judge Groves on the right. Turn right and go east along the south side of office building for 0.05 mile to the station on the left as described.

All marks are standard disks set in round concrete posts.

Station mark, stamped CALJUD 1970, is set flush with the ground surface. It is 99.0 feet east-southeast of the southeast corner of a building, 43 feet north of a canal bank, 43 feet east of a hedgerow and 11.0 feet southeast of a metal witness post and sign.

Reference mark 1, stamped CALJUD NO 1 1970, is flush with the ground surface. It is 80.3 feet southeast of a metal witness post and sign, 12.0 feet south of center of a field road and 2.5 feet north of a canal bank.

Reference mark 2, stamped CALJUD NO 2 1970, is flush with ground surface. It is 39.0 feet north of a canal bank, 34.6 feet southeast of the southeast corner of a building and 3 feet south of a hedgerow.

Azimuth mark, stamped CALJUD 1970, projects 3-inches. It is 298 feet east of center of sand road, 18 feet south of the edge of orange grove, 7 feet south of center of a field road and 2 feet west of a metal witness post and sign.

*Refers to notes in manuals of triangulation and state publications of triangulation. †Direction-angle measured clockwise, referred to initial station. ‡To nearest meter only, when no trigonometric leveling is being done.

USCOMM-DC 37171-P68

QUAD. 260904

RECOVERY NOTE, TRIANGULATION STATION

NAME OF STATION: CHASTAIN
ESTABLISHED BY: D.A.J.' YEAR: 1953 STATE: Florida BENCH MARK ALSO
RECOVERED BY: *C.L. Hardt YEAR: 1970 COUNTY: Palm Beach
AIRLINE DISTANCE AND DIRECTION FROM NEAREST TOWN: 6 miles southeast of Port Kayaca
HEIGHT OF TELESCOPE ABOVE STATION MARK 90 FEET. HEIGHT OF LIGHT ABOVE STATION MARK 100 FEET.

DISTANCES AND DIRECTIONS TO AZIMUTH MARK, REFERENCE MARKS AND PROMINENT OBJECTS WHICH CAN BE SEEN FROM THE GROUND AT THE STATION				
		DISTANCE		DIRECTION
OBJECT	BEARING	FEET	METERS	
				° ′ ″
CAN RM 3				00 00 00.0
RM 2	NNW	141.94	(43.263)	38 46 38
AZ MK	N	(0.2 mile)		119 15 54.9
RM 1	NE	93.22	28.415	172 22 38
RM 1 to RM 2		216.99	(66.138)	

The station was recovered as described with the exception of the property owner and the to reach. Due to these changes a complete new description follows.

Station is located 8 miles northeast of Canal Point, 6 miles east of Lake Okeechobee, 3 miles south of the Martin County Line and on the property of John G. DuPuis Jr.

To reach the station from the junction of State Highways 76 and 710 at the overpass in the southeast edge of Indian Town, go westerly on State Highway 76 for 4.9 miles to a road left leading to the office of the White Belt Ranch. Turn left then right and go westerly along fence for 0.35 mile to a road left. Turn left on sand road and go southerly for 3.2 miles to a locked gate, pass through gate and follow track road southwesterly for 0.8 mile to a gate at a fence line on the right. Continue on track road along fence line and go southerly for 2.2 miles to the azimuth mark on the right. Continue southerly on track road for 0.2 mile to corral on right and the station on left as described.

Station mark, stamped CHASTAIN 1953, is a standard disk set in a square concrete post which projects 2-inches. It is 86 feet northeast of corral chute, 78 feet south-southeast of the junction of a track road forks, 22 feet southeast of center of a track road and 4.7 feet east of a metal witness post and sign. (Note:1a,7a)

Reference mark 1, stamped CHASTAIN NO 1 1953, is a standard disk set in the top of a square concrete post which projects 6-inches. It is 87 feet southeast of the junction of track road forks, 44.6 feet northeast of a 10-inch pine tree and 1.6 feet southwest of a metal witness post and sign. (Note: 11a)

Reference mark 2, stamped CHASTAIN NO 2 1953, is a standard disk set in the top of a square concrete post which projects 6-inches. It is 39.3 feet south of a 14-inch pine tree, 24.6 feet northeast of center of a gate, 1.6 feet southeast of a metal witness post and sign and 1.4 feet northeast of a fence. (Note: 11a)

Azimuth mark, stamped CHASTAIN 1953, is a standard disk set in the top of a square concrete post which projects 2-inches. It is 40 feet northwest of the junction of track road fork, 13 feet west of center of track road and 2 feet east of a metal witness post and sign.(Note 16a)

*Name of chief of party should be inserted here. The person who actually visited the station should sign his name at the end of the recovery note.

FORM C&GS-526a (12-68)
USCOMM-DC 58181-P68

U.S. DEPARTMENT OF COMMERCE
COAST AND GEODETIC SURVEY

Figure 9

consideration of ties to intermediate established control or to any lengths or azimuths observed in the project. Plane coordinates are not computed for field positions.

In some instances it is not possible or feasible to immediately adjust a field project upon completion, and on occasion this could understandably present a problem to a user who may urgently require a high degree of relative accuracy between a few points. The NGS, in such cases, will provide upon request, positions and plane coordinates for specific points which will be internally consistent; and although the final adjusted data may differ somewhat from these values, the differences will be more or less constant in a general area.

Survey Data on Other Datums and Spheroids: The principal purpose for establishing geodetic surveys during the early years of the Coast and Geodetic Survey (originally known as the Survey of the Coast and then the Coast Survey) was to determine the relationship of our coastal cities in order to place the hydrographic surveys of the coast, rivers, and harbors and the resulting charts and maps on a single base or datum. Ideally the coastal surveys should have been planned and executed in a continuously connected manner, but, of course, such a plan was not possible or in truth actually necessary. Consequently, many of the harbors and rivers were surveyed on independent systems long before the establishment of the national network in their areas, and while the vast majority of this work was eventually computed on the North American datum (or its equivalents, the New England datum or the U. S. Standard datum) many of the stations involved were not recomputed on the North American 1927 datum. Prior to the adoption of the New England datum in 1880, the computations were carried out on the Bessel spheroid and undoubtedly not all stations computed on this spheroid were converted to the Clarke Spheroid of 1866 when it was adopted in 1880.

Many of these early stations which are not included in today's published files appeared on maps and charts and were used in surveys of the time, and indeed some may still physically exist. Regardless, their value in resurveys, erosion studies, and other research endeavors is considerable. Annually numerous requests for conversion of these points to the North American 1927 datum are received, and occasionally the requests are of such a nature that a review of the original field records is involved. Fortunately, these early records are readily accessible but often the research required to resolve a particular problem entails a very large effort. In such

cases, it may be necessary to require reimbursement for gathering, reviewing, and evaluating the data.

Physical Geodesy Data

These data refer to the physical properties of the earth's gravity field, insofar as they are applied in geodesy. The fundamental parameters are gravity intensity, astronomic position, and their temporal variations. Deflections of the vertical and geoidal separations are major elements related to the precise size and shape of the earth. Knowledge of the intensity and direction of the gravity field at points on and above the earth's surface is essential in studying the earth's international constitution, in metrology, and in space technology applications. Polar variation, or the wobble of the earth's axis within the body of the earth, is also included. Data are available in tabular form or in certain cases on charts showing contours of gravity intensity anomalies or geoidal separations.

Listed gravity data are compiled for distribution by NGS. There is available an index map showing the current density of stations by 1° x 1° square subdivisions. The data are in automated format and can be furnished for any selected area in the form of punch cards, printouts, or magnetic tape. A sample listing is shown in Figure 10.

Astronomic data are available for more than 2,000 stations in the U. S. and territories. The data are maintained in a card file, one card for each station. Copies of the cards are furnished on request, and contain final results in latitude, longitude, and azimuth; precision figures; and deflections of the vertical where available. A sample data card is shown in Figure 11. Much of these data are now available on computer listings.

Anyone considering the observation of astronomical azimuths should consult the following references prior to initiating operations. Further details with respect to the authors and sources will be found with the list attached to this paper.

(1) Astronomical Azimuths for Local Control
(2) Ephemeris Time and Universal Time

GRAVITY LIBRARY - AUGUST 19 1970
LATITUDE 24 00.00 THRU 32 00.00
LONGITUDE 78 00.00 THRU 85 00.00

LATITUDE	LONGITUDE	TYPE UNIT	ELEVATION METERS	OBSERVED GRAVITY GALS	FREE AIR ANOMALY	BOUGUER ANOMALY	ISO CR TC	SOURCE	BASE STA REFERENCE	SEQUENCE	STD DEV FREE AIR	STD DEV BOUGUER
+28 27.70	- 80 32.40	1	+ 2.0	979.24580	+ 26.7	+ 26.5		361	21750	656	1	1
+28 27.80	- 80 34.20	1	+ 3.0	979.24310	+ 24.2	+ 23.9		361	21750	656	1	1
+28 28.00	- 80 35.40	1	+ 4.1	979.24070	+ 21.9	+ 21.4		361	21750	656	1	1
+28 28.10	- 80 32.00	1	+ 2.4	979.24700	+ 27.5	+ 27.3		361	21750	656	1	1
+28 28.10	- 80 32.60	1	+ 2.7	979.24620	+ 26.8	+ 26.5		361	21750	656	1	1
+28 28.40	- 80 42.50	1	+ 1.8	979.22320	+ 3.2	+ 3.0		361	21750	656	1	1
+28 28.50	- 80 34.70	1	+ 1.8	979.24350	+ 23.4	+ 23.2		361	21750	656	1	1
+28 28.60	- 80 32.20	1	+ 2.4	979.24760	+ 27.5	+ 27.2		361	21750	656	1	1
+28 28.70	- 80 33.40	1	+ 2.0	979.24600	+ 25.7	+ 25.4		361	21750	656	1	1
+28 29.00	- 80 33.90	1	+ 2.3	979.24580	+ 25.2	+ 24.9		361	21750	656	1	1
+28 29.10	- 80 32.50	1	+ 2.1	979.24790	+ 27.1	+ 26.9		361	21750	656	1	1
+28 29.20	- 80 35.00	1	+ 2.4	979.24420	+ 23.4	+ 23.1		361	21750	656	1	1
+28 29.20	- 80 35.00	1	+ 3.4	979.24380	+ 23.3	+ 22.9		361	21750	656	1	1
+28 29.50	- 80 33.60	1	+ 2.3	979.24680	+ 25.6	+ 25.3		361	21750	656	1	1
+28 29.50	- 80 34.60	1	+ 2.6	979.24470	+ 23.5	+ 23.3		361	21750	656	1	1
+28 29.80	- 80 32.80	1	+ 2.4	979.24880	+ 27.2	+ 26.9		361	21750	656	1	1
+28 30.00	- 80 34.50	1	+ 2.8	979.24570	+ 24.0	+ 23.7		361	21750	656	1	1
+28 30.60	- 80 33.40	1	+ 2.1	979.24850	+ 25.8	+ 25.6		361	21750	656	1	1
+28 30.70	- 80 34.10	1	+ 2.5	979.24750	+ 24.8	+ 24.5		361	21750	656	1	1
+28 31.30	- 80 47.00	1	+ 4.9	979.23850	+ 15.8	+ 15.2		361	21750	656	1	1
+28 31.40	- 80 33.50	1	+ 4.7	979.24850	+ 25.6	+ 25.1		361	21750	656	1	1
+28 31.50	- 80 33.80	1	+ 2.7	979.24870	+ 25.1	+ 24.8		361	21750	656	1	1
+28 31.50	- 80 34.70	1	+ 2.4	979.24680	+ 23.1	+ 22.8		361	21750	656	1	1
+28 31.60	- 80 36.90	1	+ 2.4	979.24020	+ 16.3	+ 16.1		361	21750	656	1	1
+28 32.46	- 81 20.16	1	+ 34.0	979.21789	+ 2.7	- 1.0	1	2733		191		
+28 32.77	- 81 20.27	1	+ 34.0	979.21786	+ 2.3	- 1.4		2752	1650	5084	2	1

Figure 10

NOAA FORM 76-49 (4-71)

U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

Quad. 290812

State Florida

Station: FAVORETTA 1934

ASTRONOMY, ABSTRACT OF RESULTS

LATITUDE

Station FAVORETTA 1934 Chief of Party L. S. Baker

Observer R. B. Gassett Date 26 Sept. 1962

	PRELIMINARY	FINAL	INSTRUMENT NO.	CHRONOMETER NO.
Mean Observed Latitude	29° 22′ 06.″51	± 0.″08	T-4 33114	7897

Reduction to Sea Level (m.) 0.00

Variation of Pole C.I.0.1968 BIH -.10

Eccentric Reduction—in Latitude +0.31

No. of Observations: Accepted 16; Rejected 0

in Longitude +1.″24

			VALUE OF 1/2 TURN OF MICROMETER
Astronomic Latitude (ϕ_A)	29° 22′	06.″72 ± 0.″08	76.6512 ± .0258
Geodetic Latitude (ϕ_G)	29° 22′	04.404	±
Deflection in the Meridian ($\phi_A - \phi_G$)		+2.42	(λ_G) 81° 11′ 06.809

Remarks: None x = +.007
y = +.102

LONGITUDE

Station FAVORETTA 1934 Chief of Party L. S. Baker

Observer R. B. Gassett Date 1 Oct. 1962

	PRELIMINARY	FINAL	INSTRUMENT NO.	CHRONOMETER NO.
Mean Observed Longitude, Time	05h 24m s	44.s298 ± 0.s008	T-4 33114	7897
Mean Observed Longitude, Arc	81° 11′	04.″47 ± 0.″12	NO. OF SETS 4	

Eccentric Reduction—in Longitude +1.24 in Latitude +0.31

Variation of Pole C.I.0.1968 BIH +.01

Astronomic Longitude (λ_A) 81° 11′ 05.″72 ± 0.″12 Cos ϕ .8715

Geodetic Longitude (λ_G) 81° 11′ 06.809 (ϕ_G) 29° 22′ 04.404

Deflection in Longitude ($\lambda_A - \lambda_G$) -1.09

Deflection in Prime Vertical ($\lambda_A - \lambda_G$) Cos ϕ -0.95

Remarks: None x = -.003
y = +.102

AZIMUTH

Station FAVORETTA 1934 Mark WELCOME 3

Observer H. C. Howes, N. E. Matlock Date 18, 19 Oct. 1962

Chief of Party S. C. Miller Instrument No. T-3 53077

Mean Observed Azimuth	148° 05′	05.″66 ± 0.″24	No. of Observations: Accepted 31; Rejected 1
Diurnal Aberration		+0.32	
Elevation of mark (m.)		0.00	Sin ϕ .4904 Cos ϕ
Eccentricity		0.00	(ϕ_G) 29° 22′ 04.″404
Variation of Pole C.I.0.1968 BIH		-.07	(λ_G) 81° 11′ 06.″809
Astronomic Azimuth (α_A)	148° 05′	05.″91 ± 0.″24	(α_G)
($\lambda_A - \lambda_G$) -1.09	($\lambda_A - \lambda_G$) Sin ϕ	-0.53	($\alpha_A - \alpha_G$) Cot ϕ
Laplace Azimuth	148° 05′	05.″38	$-(\alpha_A - \alpha_G)$ Cot ϕ

Remarks: None x = -.042
y = +.110

Figure 11

ACCESSION NUMBERS 872 A 1962
Vol. 18,19 G-12984 A-3047

USCOMM-DC 34242-P71

Vertical Control Data

Quad Type Format: Figures 12, 13, and 14 illustrate the format used in tabulating Vertical Control Data on the quad system. The line numbers do not correspond to those shown on the State leveling diagrams or necessarily the same as that assigned when the line continues into adjacent quads. In crustal movement or subsidence areas, several elevations identified by the year in which the observations were made are often listed for each bench mark.

Listings by Lines: In some States and localities within States which have not been completely converted to the quad-type publication, leveling control is published by lines whose numbers correspond to those shown on the State leveling diagrams. This format is quite similar to the quad type and no examples will be shown here. In the oldest listings there may be no route sketch included and the elevations are often tabulated with the bench mark descriptions rather than in separate lists. Also, for all types of listings which follow this general format, when a line extends into another State, the line number may not be identical.

Field Elevations: Unadjusted field elevations are generally available shortly after the completion of a project. These data, as for any material that has not been verified or adjusted in the office, must be used with due caution.

Accuracy of Horizontal Control Stations

The accuracy of control points published as part of the national network is noted on the listings of geographic positions or the data sheet for each point or can be ascertained. With few exceptions, stations forming the basic network have been established by one federal agency (the Coast and Geodetic Survey, now the National Geodetic Survey, NOS) and since about 1940 the standards and specifications employed have been continually upgraded for first- and second-order surveys. At the present time, all primary arcs and area networks are accomplished to first-order (1:100,000) standards. On occasion, supplemental surveys may be performed to second-order class I (1:50,000) standards, and in rare instances to second-order class II (1:20,000) criteria.

U.S. DEPARTMENT OF COMMERCE
ENVIRONMENTAL SCIENCE SERVICES ADMINISTRATION
COAST AND GEODETIC SURVEY

VERTICAL CONTROL DATA

by the

Coast and Geodetic Survey

SEA-LEVEL DATUM OF 1929

QUAD - - - - - - - - - 290812
FLORIDA
LATITUDE 29°00' TO 29°30'
LONGITUDE 81°00' TO 81°30'
DIAGRAM DAYTONA BEACH NH 17-8

290812

Miles
0 5 10

Figure 12

REPLACES EARLIER LISTS

USCOMM-ESSA-ASHEVILLI

U.S. DEPARTMENT OF COMMERCE
ENVIRONMENTAL SCIENCE SERVICES ADMINISTRATION
COAST AND GEODETIC SURVEY

VERTICAL CONTROL DATA

by the

Coast and Geodetic Survey

SEA-LEVEL DATUM OF 1929

FLORIDA
LATITUDE 29°00' TO 29°30'
LONGITUDE 81°00' TO 81°30'
DIAGRAM DAYTONA BEACH NH 17-8

REPLACES ELEVS. OF DEC. 1963

For tidal bench marks included in this list, elevations with respect to local tidal datum planes are available and may be obtained by writing to: ENVIRONMENTAL SCIENCE SERVICES ADMINISTRATION, COAST AND GEODETIC SURVEY, WASHINGTON SCIENCE CENTER, ROCKVILLE, MARYLAND 20852.

LINE 101
(First-order)

This line follows the Florida East Coast Ry. and U.S. Hwy. 1 SE through Daytona Beach to the end of the quad.

The original field work (L-698) was done in the winter of 1932-33 by a party supervised by A.L. Wardwell. Additional leveling (L-11284) was done to Daytona Beach Municipal Airport in 1945 by a party supervised by G.C. Mast. The entire line was releveled (L-20113) from Nov. 1964 through January 1965 by a party supervised by R.R. Gerrish.

These elevations are derived from the latest leveling and are based on a supplementary adjustment of 1966.

BENCH MARK	ADJUSTED (Meters)	ELEVATION (Feet)
J 31	8.775	28.789
P 223	7.827	25.679
Q 223	7.573	24.846
M 31	7.568	24.829
R 223	8.446	27.710
S 223	6.108	20.039
N 31	DESTROYED	
V 226	6.140	20.144
U 223 (SRD)	6.560	21.522
T 223 (SRD)	6.510	21.358
P 31	DESTROYED	
WELCOME RM 3	6.411	21.033
WELCOME 3 RM A	6.517	21.381
WELCOME 3 RM 5	6.691	21.952
WELCOME RM 2	6.857	22.497
M 226	7.651	25.102
L 226 (SRD)	8.165	26.788
Q 31	7.953	26.092
N 226 (SRD)	8.546	28.038
P 226	8.850	29.035
U 226	9.749	31.985
Q 226	8.609	28.245
R 31	8.833	28.980
FAVORETTA RM 1	8.779	28.802
T 226 (C&GS & SS)	8.713	28.586
FAVORETTA RM 2	8.351	27.398

*Changed elevation.

LINE 101
(Continued)

BENCH MARK	ADJUSTED (Meters)	ELEVATION (Feet)
FAVORETTA	8.392	27.533
FAVORETTA RM 3	8.204	26.916
T 14 (C&GS&SS)	9.103	29.865
A 225	9.071	29.760
T 13 (C&GS&SS)	9.828	32.244
*S 31	9.945	32.628
G 225	9.691	31.795
T 12 (C&GS&SS)	9.331	30.613
X 226	9.322	30.584
H 225	8.526	27.972
T 11 (C&GS&SS)	7.106	23.314
T 31	4.611	15.128
B 225	5.232	17.165
J 225	2.064	6.772
K 225	2.552	8.373
T 8 (C&GS&SS)	1.420	4.659
U 31	DESTROYED	
S 226	2.216	7.270
ORMOND RM 3	2.478	8.130
L 225	2.631	8.632
T 6 (C&GS&SS)	2.139	7.018
V 31	1.797	5.896
T 5 (C&GS&SS)	1.905	6.250
N 225	1.802	5.912
M 225	2.042	6.699
P 225	1.558	5.112

SPUR LINE EAST TO TIDAL BENCH MARKS AT DAYTONA BEACH

X 31	1.555	5.102
DAYTONA RM 3 AZ	1.234	4.049
TIDAL STA. I-48 11.476 (SRD)	2.932	9.619
TIDAL STA. I-48 BM BRIDGE A IA	2.963	9.721
TIDAL STA. I-48 11.982 (SRD)	3.099	10.167
TIDAL STA. I-48 TIDAL 9	4.637	15.213
*TIDAL STA. I-48 TIDAL 6	4.782	15.689
*TIDAL STA. I-48 TIDAL 4	3.318	10.886
DAYTONA BEACH (C of D)	4.040	13.255
13.225 (C of D)	3.975	13.041

LINE 101
(Continued)

BENCH MARK	ADJUSTED (Meters)	ELEVATION (Feet)
TIDAL STA. I-48 TIDAL 3	DESTROYED	
*TIDAL STA I-48 TIDAL 8	5.051	16.571
TIDAL STA I-48 TIDAL 10	7.013	23.008
TIDAL STA I-48 TIDAL 2	5.622	18.445
*TIDAL STA I-48 TIDAL 7	3.326	10.912
*TIDAL STA I-48 TIDAL 1	3.310	10.860

END OF SPUR LINE

SPUR LINE TO DAYTONA BEACH MUNICIPAL AIRPORT

B 123	3.115	10.220
*D 123	9.392	30.814
C 123	9.152	30.026
F 123	8.978	29.455
E 123	10.194	33.445
Barometer No.466	10.302	33.799
ARP NO. 2	9.817	32.208
HIGH POINT		34.0
TBM 177 H	8.626	28.300
K 13 (FLA.G.S.)	NOT RECOVERED	
DAYPORT	8.701	28.547
DAYPORT RM 2	8.553	28.061
*DAYPORT RM 3	8.899	29.196

END OF SPUR LINE

W 31	1.901	6.237
Q 225	2.137	7.011
T 1 (C&GS&SS)	2.806	9.206
R 225	3.648	11.968
R 225	4.450	14.600
*Y 31	3.450	11.319
S 225	3.116	10.223

LINE 102
(Second-order)

This line follows State Hwy. 40 A NW.

The field work (L-15834) was done in May and June 1956 by a party supervised by H.D. Nygren. Releveling (L-19549) was done from triangulation station Creep 2 to the end of the line in August 1963 by a party supervised by L.S. Baker.

The original elevations are based on a supplementary adjustment of 1956. The 1963 elevations are based on a supplementary adjustment of 1964.

BENCH MARK	ADJUSTED (Meters)	ELEVATION (Feet)
SMYRNA	8.756	28.727
SMYRNA RM 1	8.826	28.957
SMYRNA RM 3	8.462	27.762
K 82 (C&GS-SS)	8.310	27.262
P 167	7.822	25.663
R 167	7.719	25.325
K 78 (C&GS-SS)	7.004	22.979
CREEP AZI	7.196	23.609
CREEP	6.904	22.651
CREEP 2	6.913	22.680
CREEP 2 RM 1	6.872	22.546
CREEP 2 RM 2	6.824	22.388

LINE 103
(Second-order)

This line follows the Atlantic Coast Line RR NW from the junction of Line 104 to the end of the quad.

The field work (L-1444) was done in April 1934 by a party supervised by W.R. Tucker.

These elevations are based on a supplementary adjustment of 1940.

BENCH MARK	ADJUSTED (Meters)	ELEVATION (Feet)
L 80	16.964	55.656
M 80	23.875	78.330
N 80	11.709	38.415
P 80	13.251	43.474
Q 80	15.967	52.385

Figure 13

FEBRUARY 1970

U. S. DEPARTMENT OF COMMERCE
ENVIRONMENTAL SCIENCE SERVICES ADMINISTRATION
COAST AND GEODETIC SURVEY

REPLACES DESCR. OF DEC. 1965

VERTICAL CONTROL DATA
by the
Coast and Geodetic Survey
SEA-LEVEL DATUM OF 1929

QUAD 290812 PAGE NO. 1
FLORIDA
LATITUDE 29°00' TO 29°30'
LONGITUDE 81°00' TO 81°30'
DIAGRAM DAYTONA BEACH NH 17-8

LINE 101

RECOVERY NOTE, BENCH MARK

R

Designation J 31 | State Florida | County Flagler
Nearest town Espanola | Described in | Chief of party R.R. Gerrish
Distance and direction from nearest town 1.3 southeast | Recovery date 11/64
Character of mark C&GS Bench Mark Disk | Established by C&GS | Stamping J 31 1932 28.789
Also horizontal control point ☐ | Present condition Good
Detailed report: 1.3 miles southeast along the Florida East Coast Railway from the crossing of State Highway S205 at Espanola, at a private road crossing, 1.0 miles southeast of bench mark M 223, 0.4 miles northwest of milepost P 84, 160.0 feet southwest and across railroad track from the center line of State Highway S-13, 54.0 feet aouth of the center of the private road crossing, 45.9 feet southwest of the southwest rail of tracks, 26.5 feet southeast of the center line of sand road, 3.0 feet northeast of the southwest railroad right of way fence, 1.5 feet northwest of a metal witness post, about 1.0 feet below the level of the top of the track and is a concrete post which projects 1 inch above the surface of the ground.

Recovered as Described NOV-1964

DESCRIPTION OF BENCH MARK

Designation P 223 | State Florida | County Flagler
Nearest town Bunnell | County Flagler | Chief of party R.R. Gerrish
Distance and direction from nearest town 3.25 miles northwest | Leveling date 11/64
Character of mark C&GS Bench Mark Disk | Stamping P 223 1964
Established by C&GS
Detailed description 3.25 miles northwest of and along the Florida East Coast Railway from the station at Bunnell, near the driveway to a house, 0.8 miles southeast of bench mark J 31, 0.4 miles southeast of milepost 84, 122.3 feet northeast of and across State Highway S 13 from the northeast rail of track, 55.0 southeast of the center line of the northwest driveway to the house, 50.0 feet northeast of the center line of State Highway S 13, 46.0 feet east of the southeast end of the northeast one of two 24 inch galvanized pipe culvert under the driveway, 2.2 feet southwest of a yard fence, 1.5 feet southeast of a State Highway right of way concrete marker, 1.5 feet from the metal witness post, the mark is about level with the highway and is a concrete post which projects 2 inches above the ground.

The mark may also be reached by going 2.1 miles southeast along the Florida East Coast Railroad from the crossing of State Highway 205 at Espanola.

DESCRIPTION OF BENCH MARK

Designation Q 223 | State Florida | County Flagler
Nearest town Bunnell | County Flagler | Chief of party R.R. Gerrish
Distance and direction from nearest town 1.45 miles northwest | Leveling date 11/64
Character of mark C&GS Bench Mark Disk | Stamping Q 223 1964
Established by C&GS
Detailed description 1.45 miles northwest of and along the Florida East Coast Railway from the station at Bunnell, 0.8 miles southeast of bench mark P 223, 0.7 miles northwest of State Highway 20 and 100 overpasa over the track, near the junction of old S-13 and new S-13, 0.2 miles southeast of milepost P 85 (34½ rails, 33 foot rails), 108.0 feet south of the center line of the new state highway 13 (measured at the curve in the higway, 126 yards SE of a private road crossing, 40.5 feet northeast of the northeast rail, 29.0 feet southwest of the center line of the old highway, 1.5 feet northwest of a metal witness post, about 2.0 feet below the top of the rail and is a concrete post which is projecting about 5 inches above the surface of the ground.

RECOVERY NOTE, BENCH MARK

R

Designation M 31 | State Florida | County Flagler
Nearest town Bunnell | Described in | Chief of party R. Gerrish
Distance and direction from nearest town 0.85 mile northwest | Recovery date 12/64
Character of mark A C&GS Bench Mark Di | Established by C&GS | Stamping M 31 1932 24.829
Also horizontal control point ☐ | Present condition Good
Detailed report: 0.85 mile northwest along the Florida East Coast Railway from the station at Bunnell, 0.1 mile northwest of the State Highway 100 over-pass, set in the top and at the northeast corner of a 2-by-2 foot abandoned concrete base for signal at mileage pole 29.43 (mileage on main line), 39.5 feet west of the west rail of the main track, 6.5 feet west of the west rail of the track leading to the northwest, and about ½ foot above the level of the track.

NOTE: About 0.2 mile northwest of milepost P 86.

DESCRIPTION OF BENCH MARK

Designation R 223 | State Florida | County Flagler
Nearest town Bunnell | County Flagler | Chief of party R.R. Gerrish
Distance and direction from nearest town 0.75 miles northwest | Leveling date 11/64
Character of mark C&GS Bench Mark Disk | Stamping R 223 1964
Established by C&GS
Detailed description 0.75 miles northwest along the Florida East Coast Railway from the station at Bunnell, 0.1 miles southeast of bench mark M 31, 0.1 miles northwest of milepost P 86, set vertically in the east side at the south end of the first pier east from the west end of State Highway 20 and 100 overpass over the railroad track (first pier west of the track), 20.5 feet west of and across the track to East Palatka from the south rail of the track to St. Augustine, 7.5 feet west of the west rail of the track to East Palatka, 2.0 feet north of the south end of the pier, 2 feet above the top of the rail.

Figure 14

Prior to this time, most basic area networks were established to standards approaching first-order; but due to the lack of sufficient scale and a very slight reduction in the specifications, this work has been classifield as second-order. There is little doubt that with the introduction of a few measured distances the majority of these area nets can be upgraded to minimum first-order standards. As presently adjusted, however, the relative accuracy of many stations may barely meet the listed standard and in some isolated instances perhaps less. Where such conditions exist, the cause in almost every case can be traced to the piecemeal manner in which the network was adjusted. Plans are underway for a new adjustment, and these results will much better reflect the excellent quality of the observations.

For many years, in an effort to provide the local surveyor or engineer with convenient control, a large number of stations, supplemental to the basic net, was established along highways or other easy-to-reach locations. The observations involved with these points are generally of the same precision and quality as the basic stations and acceptable geometry was usually obtained; however, no effort was made to establish continuous chains. As a result, stations located quite close to one another, but not connected, may have relative accuracies somewhat less than the stated standard. At the time much of this work was accomplished, few local practitioners had the equipment or trained personnel to meet even these lessened standards, and there did not seem to be any reason for concern about the possible less-than-desirable relationship of these points. About a decade ago, however, with the increased use of electronic distancers and quality theodolites at all levels of the surveying profession, it was realized this practice could no longer be tolerated and a decision was made to connect all points which were within a specified distance. This specification is known as the 20% rule and is rather rigorously followed. Essentially the rule states that a connection will be made between two points whenever this distance is 20% or less than the total distance along the shortest directly connected route between the points. For example, in Figure 15, VERONA should have been connected to KOLLATH because this distance is less than 20% of the shortest directly connected route, KOLLATH-HILT + HILT-VERONA. Similarly, a connection SAUK-MARXVILLE should

have been made since this distance is less than 20% of the sum of the distances SAUK-REUTER + REUTER-ROBSON + ROBSON-MARXVILLE. When a survey is made between two unconnected stations, an evaluation such as this should be made. Should the distance be greater than 20% of the route as described above, satisfactory results will usually be obtained, but should it be less, there is a good chance that excessive closures may result.

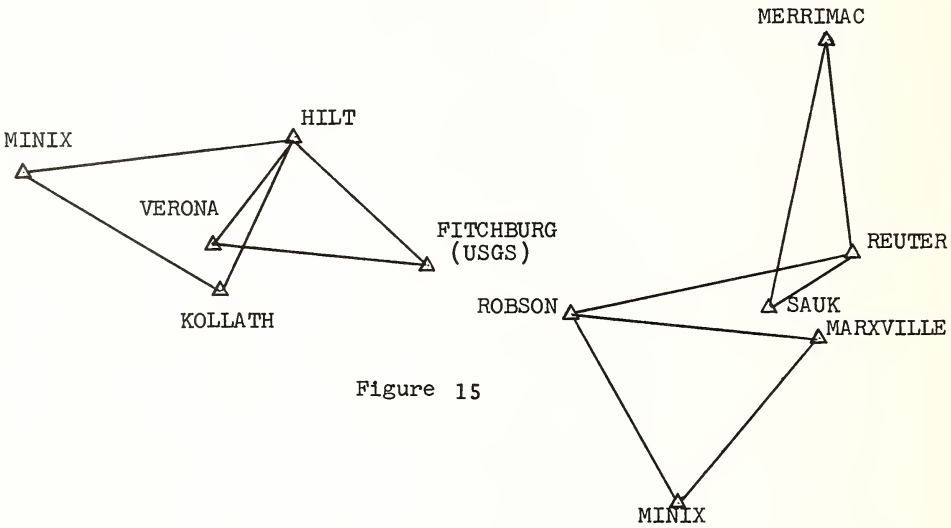

Figure 15

Another method for evaluating the control in a locality is to measure lines of the network at every opportunity. By comparing these measurements with computed or published distances, the scale differentials can be determined, and often a better understanding of the traverse closures can be obtained.

Whenever difficulties are encountered, the agency that published the data should be consulted. Often a review of the computations or a check of the field records can resolve or at least clarify a problem. On occasion, revisions will be made to the published data when serious distortions in the network are uncovered by additional observations. When these recomputations are made, observations secured by other organizations, private and public, will be included providing these data are furnished and were obtained by acceptable survey practices.

APPLICATION

Geodetic data have numerous applications, some having little to do with surveying per se, but no effort will be made here to expound on this subject except to note that the results of geodetic operations affect most everyone's daily life in one way or another. The publications given in the Bibliography contain numerous examples of the application of geodetic data. In a short presentation such as this paper, it is thought the possible solution to a particular problem is more worthwhile than an enumeration of the attributes of geodetic control data.

Accordingly, one of the major user complaints is the lack of orientation at a station site or the blockage of the lines of sight to the azimuth mark or some other point which could be used to provide orientation.

On these occasions, the only solution would seem to be astronomical observations. In many instances, however, a variety of "tricks of the trade" can often be employed and the astronomic work may not be necessary. Figures 16, 17, and 18 and the accompanying text describe some of the methods that have proven successful. In addition to these procedures, there are numerous other geometrical and trigonometrical innovations that can be employed by imaginative surveyors. These practices would not be suggested for surveys where results better than 1:15,000 are expected, but could be used in higher grade surveys as a check providing good quality orientation has been introduced elsewhere in the traverse.

In the examples shown in Figures 16 and 17, A is a point on a traverse terminating at control point FIXED. The line between FIXED and its azimuth mark is obstructed. An intersection point may be substituted for the azimuth mark in the example shown in Figure 17. Since this point would not normally be occupied, extra care must be exercised in making the observations, however. In this case a check of sorts would be obtained by using the traverse distance A to FIXED in the computation and comparing the computed distance between FIXED and the intersection point with that obtained from the published data. The triangle closures should seldom exceed 5".

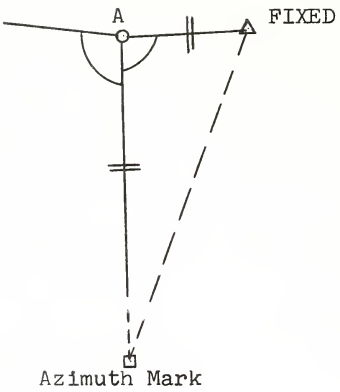

Figure 16

Refer to Figure 16

(1) Measure distance shown by two parallel cross hashes.

(2) Measure angle at A.

(3) Compute angle at Azimuth Mark by side-angle-side computation.

(4) To obtain the azimuth A to Azimuth Mark, apply computed angle at Azimuth Mark to grid (plane) azimuth FIXED to Azimuth Mark. In this example, the computed angle would be subtracted.

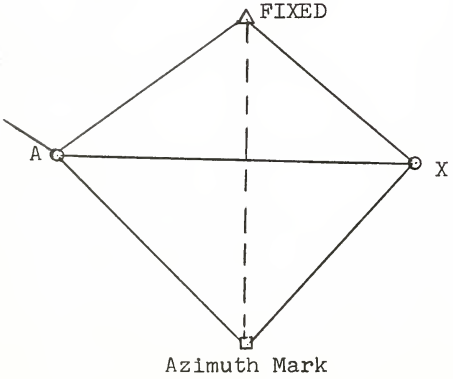

Figure 17

Refer to Figure 17

(1) Observe angles as indicated by full lines - no distances are necessary (assume a distance for one line and compute other lines).

(2) Compute angle at FIXED between Azimuth Mark and A by side-angle-side computation and use to determine the azimuth FIXED to A.

In the example shown by Figure 18, A is a point on a traverse terminating at control point FIXED (1). No azimuth control is available at FIXED (1), but orientation can be obtained at FIXED (2). FIXED (1) and FIXED (2) are not intervisible, of course; however, the azimuth could be carried between the points through one or more intermediate points.

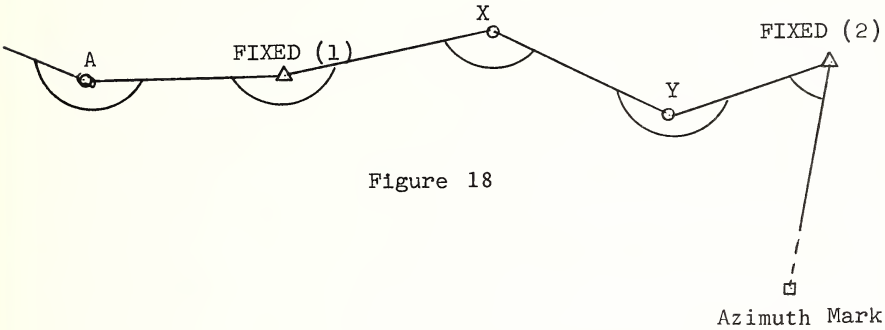

Figure 18

(1) Observed angles as indicated; no distances between FIXED (1) and FIXED (2) are required.

(2) Starting with the grid azimuth FIXED (2)-Azimuth Mark, compute the grid azimuth FIXED (1)-A using the observed angles. The distribution of the azimuth closure should be made from FIXED (2) through FIXED (1) to azimuth control.

, Classification, Standards of Accuracy, and General Specifications of Geodetic Control Surveys, Federal Geodetic Control Committee, February 1974. Available from NGS

, Control Leveling, USC&GS Special Publication No. 226.*

, Horizontal Control Data, USC&GS Special Publication No. 227.*

, Magnetic Surveys, USC&GS Serial No. 718.*

, Manual of Second-and Third-Order Triangulation and Traverse, USC&GS Special Publication No. 145.*

, Plane Coordinate Systems, USC&GS Serial No. 562.*

, Sines, Cosines, and Tangents, 0°-6°, for use in computing Lambert plane coordinates, USC&GS Special Publication No. 246.*

, Specifications to Support Classification, Standards of Accuracy, and General Specifications of Geodetic Control Surveys, Federal Geodetic Control Committee, January 1976. Available from NGS.

, State Plane Coordinate Projection Tables (Available for all states except Alaska. Computations for Alaska are made using the 2½-minute intersection tables, USC&GS Publication 65-1, Part 49 for zone 1, Part 50 for zones 2-9, and Part 51 for zone 10.*) USC&GS Special Publications.* Tables are also available for most U. S. Possessions.

, Use of Coast and Geodetic Survey Data in the Surveys of Farms and Other Properties, USC&GS Serial No. 347.*

Adams, O. S., Azimuths from Plane Coordinates, USC&GS Serial No. 584.*

Adams, O. S., and Claire, C. N., Manual of Plane Coordinate Computation, USC&GS Special Publication No. 193.*

Baker, L. S., Specifications for Horizontal Control Marks, ESSA Technical Memorandum C&GSTM-4.*

---

* Available through the Superintendent of Documents, Government Printing Office, Washington, D. C. 20402.

Brittain, J. H., Computation of Traverse by Plane Coordinates, USC&GS Serial No. 624.*

Brittain, J. H., Control Surveys and Their Uses, USC&GS Serial No. 583.*

Claire, C. N., State Plane Coordinates by Automatic Data Processing, ESSA (C&GS) Publication 62-4.*

Dracup, J. F., Application of National Geodetic Survey Practices to Local Control Surveys, New England Section ACSM Workshop, Rockport, Maine, November 1975. Available from NGS.

Dracup, J. F., Fundamentals of the State Plane Coordinate Systems, presented to the 25th Annual Surveyors Institute, University of Wisconsin, Madison, Wisconsin, December 1973. Available from NGS.

Dracup, J. F., and Kelley, C. F., Horizontal Control as Applied to Local Surveying Needs, ACSM Publication.

Dracup, J. F., Suggested Specifications for Local Horizontal Control Surveys, ACSM Technical Monograph No. CS-1. Revised April 1973.

Dracup, J. F., Standards and Specifications for Supplemental Horizontal Control Surveys, ACSM Proceedings, ACSM-ASP National Convention, Washington, D. C., 1970.

Dracup, J. F., Kelley, C. F., Lesley, G. B., and Tomlinson, R. W., Surveying Instrumentation and Coordinate Computation Workshop Lecture Notes, ACSM Publication.

Dracup, J. F., The Alaska Coordinate Systems, presented to the Alaska Surveying and Mapping Convention, Anchorage, Alaska, February 1975. Available from NGS.

Dracup, J. F., Trilateration - A Preliminary Evaluation, ACSM Proceedings, ACSM-ASP Fall National Convention, Denver, Colorado, October 1970.

Dracup, J. F., Use of Control for Land Surveys, presented at the Arkansas Association of Registered Land Surveyors - Arkansas Section ACSM, 5th Annual Convention, Hot Springs, Arkansas, April 1972. Available from NGS.

Gossett, F. R., Manual of Geodetic Triangulation, USC&GS Special Publication No. 247.*

Holdahl, J. H. and Dubester, D. C., A Computer Program for Traverse Adjustment Using Plane Coordinates, ACSM Proceedings, ASP-ACSM National Convention, Washington, D. C., March 1971. Documentation available from NGS.

PENN STATE UNIVERSITY LIBRARIES
A0000709413333

Hoskinson, A. J. and Duerksen, J. A., Manual of Geodetic Astronomy, USC&GS Special Publication No. 237.*

Kaufman, H. P., The ABC of Triangulation Adjustment, USC&GS Publication G-45. Available from NGS.

Kelley, C. F., What Data? ACSM Proceedings, ASP-ACSM Fall National Convention, San Francisco, California, September 1971.

Meade, B. K., The Practical Use of the Oregon State Plane Coordinate System, Proceedings of the 1964 Surveying and Mapping Conference, Oregon State University, Corvallis, Oregon, also available from NGS.

Mitchell, H. C., Definitions of Terms Used in Geodetic and Other Surveys, USC&GS Special Publication No. 242.*

Mitchell, H. C., Use of State Plane Coordinates in Route Surveying, USC&GS Publication 1950. Available from NGS.

Mitchell, H. C. and Simmons, L. G., The State Coordinate Systems (A Manual for Surveyors), USC&GS Special Publication No. 235. Revised June 1974.*

Poling, A. A. Jr., Astronomical Azimuths for Local Control, Surveying and Mapping, Vol. XXVII, No. 4, also available from NGS.

Poling, A. C., Elevations from Zenith Distances (Vertical Angles), USC&GS Publication G-56. Available from NGS.

Rappleye, H. S., Manual of Geodetic Leveling, USC&GS Special Publication No. 239.*

Rappleye, H. S., Manual of Leveling Computation and Adjustment, USC&GS Special Publication No. 240.*

Reynolds, W. F., Manual of Triangulation Computation and Adjustment, USC&GS Special Publication No. 138.*

Rice, D. A., Ephemeris Time and Universal Time, Surveying and Mapping, Vol. XIX, No. 3.

Simmons, L. G., Geodetic and Grid Angles - State Coordinate Systems, ESSA Technical Report C&GS 36.*

Tomlinson, R. W. and Burger, T. C., Electronic Distance Measuring Instruments, ACSM Technical Monograph No. CS-2. Revised March 1975.

Thorson, C. W., Second-Order Astronomical Position Determination Manual, USC&GS Publication 64-1.*

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